



The Lennard-Jones
Intestinal Failure Unit



Monitoring & micronutrients

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How often do you monitor?

Initial clinic visits

Weekly

Fortnightly

Monthly

3 monthly

6 monthly

Long term clinic visits

Monthly

3 monthly

6 monthly

Yearly

What does Europe do?

ESPEN-HAN working group

Questionnaire: 42 centres in 8 countries

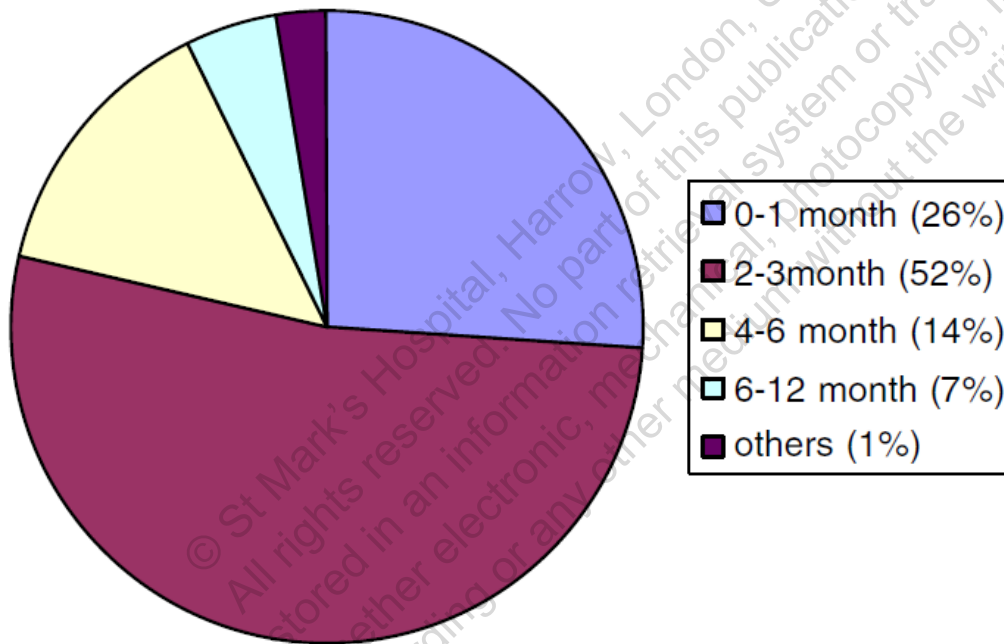
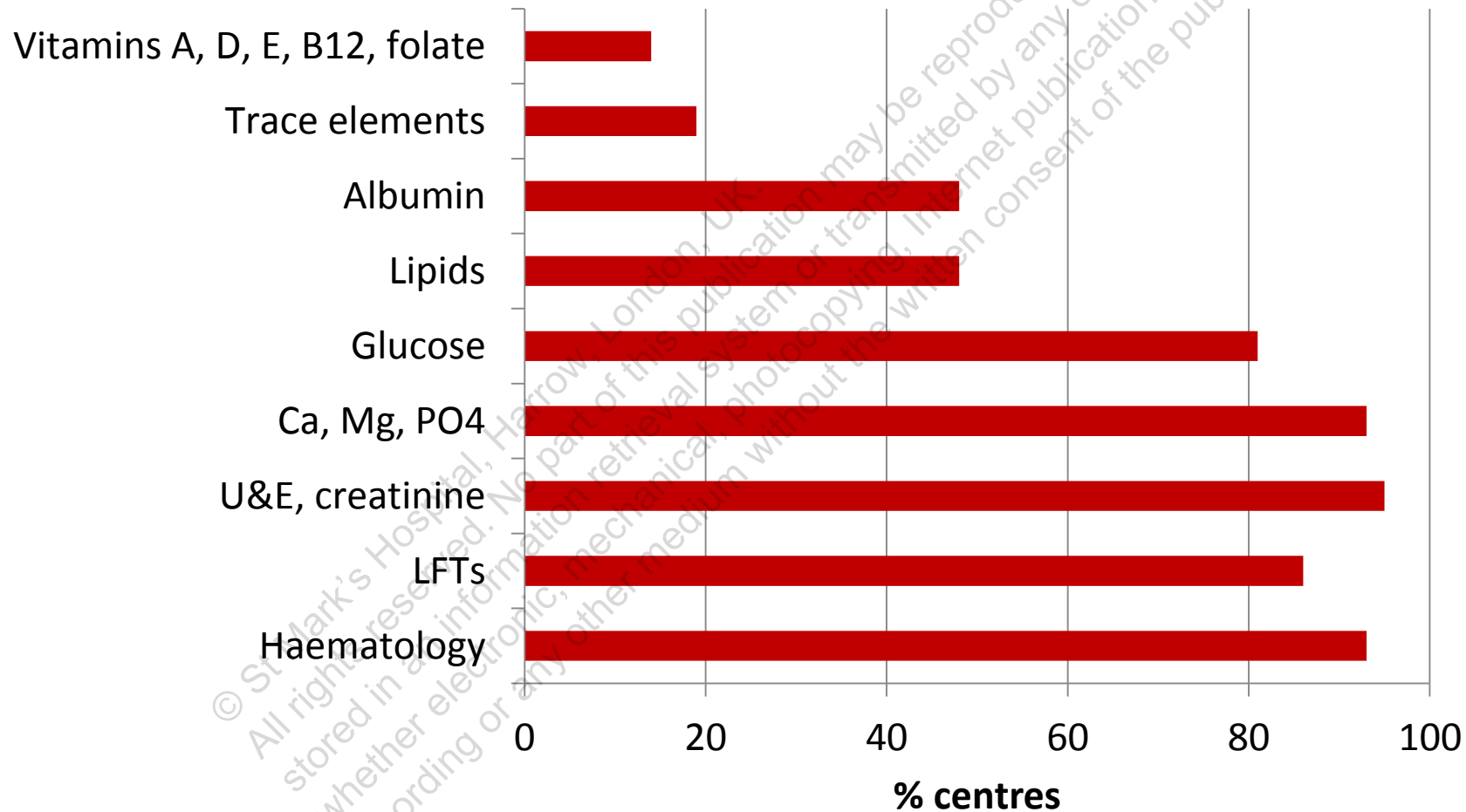


Figure 2 Distribution of intervals for monitoring of the stable HPN patient.

Blood tests: what do they measure?



What would you measure every time?

Haem & biochem

- FBC
- U&E, LFT, Ca, Mg, PO4
- CRP, ESR

Micronutrients

- Ferritin
- Selenium & Zinc
- Copper, manganese

Vitamins

- B12, folate
- A, D & E

Urine sodium

ESPEN HPN in adults

- **Purpose of the guidelines**

To highlight good practice & promote use of standardised treatment protocols

- **Identifies huge clinical experience**

Few controlled clinical studies of treatment effects & management of complications

- **Framework for development of policies & procedures**

Staun M *et al* (2009) *Clin Nutr*; 28: 467

Frequency	Measure
All visits	Biochemistry & anthropometry
6 monthly	Trace elements & vitamins
Yearly	Bone mineral density

Pironi *et al* (2016) *Clin Nutr*;35:247

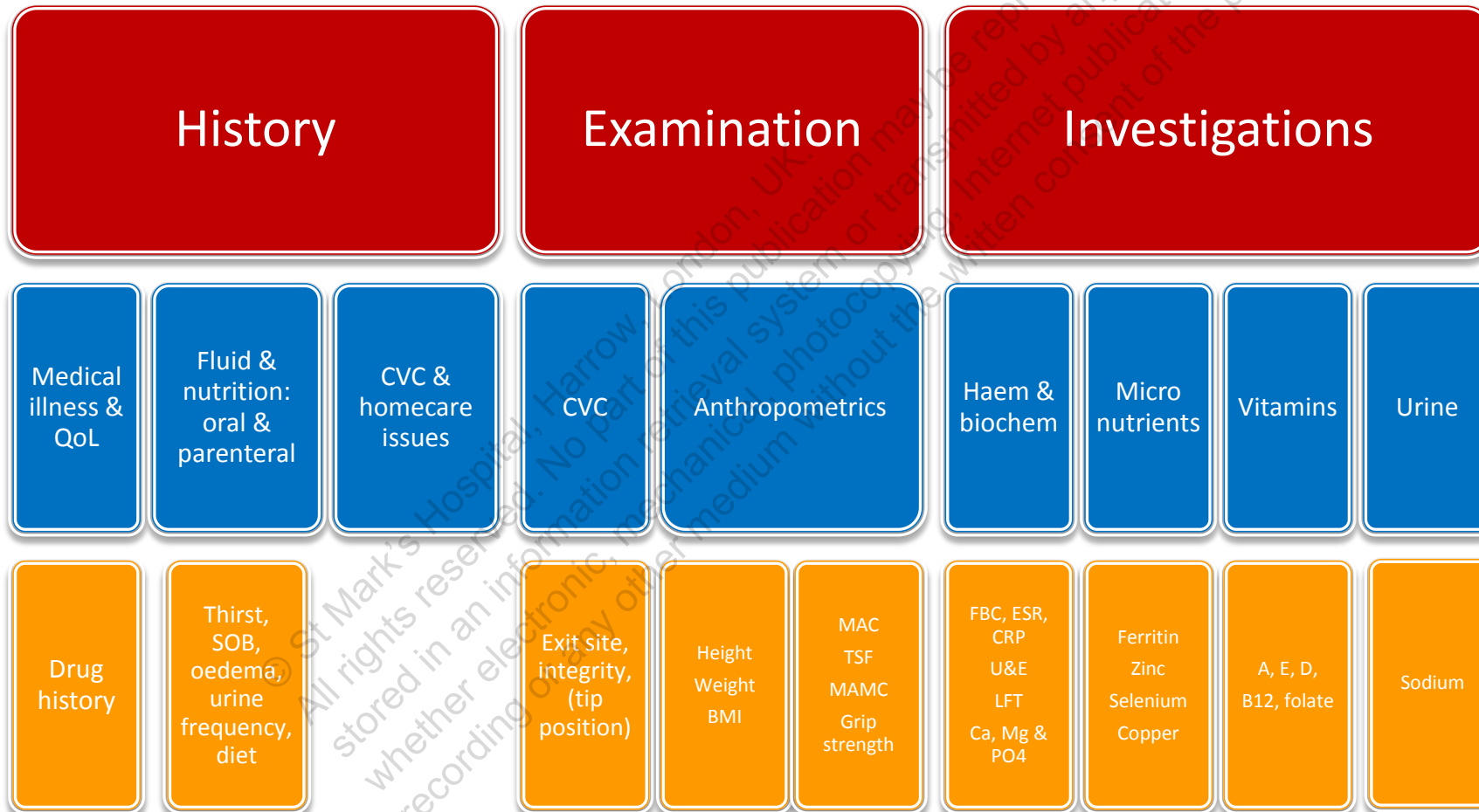
Scottish HPN managed clinical network

Frequency of HPN monitoring & consequence for complication rates

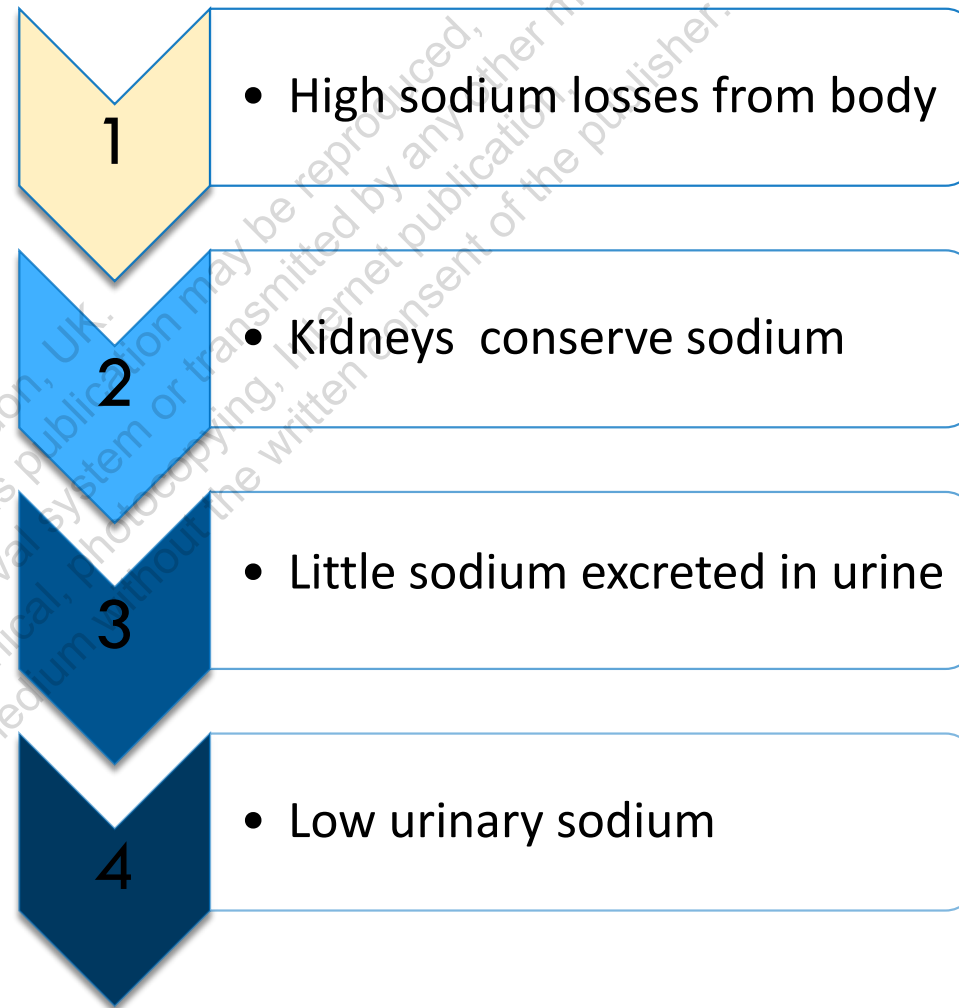
141 HPN clinic assessments for 53 patients

- 16 (30%) were seen every 100days as per guideline
- 60% reviews were within 100days of previous appointment
- Duration of HPN treatment
 - ▣ Inversely correlated with frequency of review
- Complication rates
 - ▣ Not increased in HPN patients reviewed less often

What do we do?



Urinary sodium



A value of less than 20mmol/litre suggests deficiency

NICE recommendations

- HCP with relevant skills & training in nutritional monitoring should undertake monitoring
- Review the indications, route, risks, benefits & goals of nutrition support at regular intervals
- Review those on HPN every 3-6 months at a specialist hospital clinic
- Train patients and carers to recognise & respond to adverse changes in both their well-being and in the management of their nutritional delivery system
- Some clinical observations may be checked by patients or carers

D grade evidence



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Care plan for Mr X (May 2015)

Mr X has fluctuating fluid requirements due to intestinal and heart failure, which depend on the output from his venting gastrostomy. He may quickly become dehydrated or overhydrated if the incorrect amount of intravenous fluid is given to replace his losses. He will take 1.0L of parenteral nutrition daily overnight and the quantity of additional intravenous fluids in relation to his daily needs. The following care plan provides guidance on deciding the volume of fluid required from his overnight parenteral nutrition bag or whether he requires additional intravenous fluids to maintain adequate hydration

- Mr X drinks fluids and eats small amounts of low fibre fluid foods like porridge, soup, rice pudding.
- Each day Mr X takes parenteral nutrition overnight, which provides 1.0L of fluid.
- Each day Mr X should limit his fluid intake to 750ml
- Do not have PEG on free draining. Aspirate from PEG if feeling obstructed

At the time of discharge from hospital: **Weight: 79 kg**

Daily Monitoring

- On waking-up if you feel obstructed, please venting your PEG tube then weigh yourself and record your weight on your daily weight chart.
- Over a 24hour period, measure and record your intakes and outputs on your daily fluid chart.
- Monitor signs of dehydration by noticing whether you feel thirsty, experience any dizziness on standing, pass less urine than usual or whether your urine is darker than usual (see pee chart)
- Monitor signs of over hydration by noticing whether you develop any worsening swelling of your ankles after parenteral nutrition.
- PEG to remain clamped for 60 minutes after taking medication

Use the information in the following care plan to decide your fluid requirements:

Option A Adequately hydrated

-Weight is stable -Not thirsty & passing adequate amounts of urine -No worsening ankle swelling	GIVE 1.0L of PN (overnight) over 14 hours
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Option B Dehydration

- Weight loss of more than 2kg - Feels thirsty, or - Passing less urine which is darker than usual, or - Feels dizzy on standing	GIVE 1.0L of PN (overnight) over 14 hours plus 500ml of dextrose 5% during the day over 10 hours (therefore providing an additional 500ml of fluid)
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Option C Over-hydration

- Weight gain of more than 2kg - Worsening swelling of ankles, or - Feels short of breath	GIVE 1.0L of PN (overnight) over 14 hours and aim to have minimal amounts by mouth (therefore reducing overall fluid volume of 750ml)
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If option B or C continues daily for more than one week please contact the nutrition team on 0208 235 4120

ESPEN Guidelines: Glucose

	Grade of evidence	Strength of recommendation
HPN patients have optimal blood glucose control, based on blood glucose below 10mmol/L and normal HbA1c (if diabetic) through regular monitoring	Very low	Strong

Long term glucose control

- 36 HPN patients
- On HPN 44 months
 - 5 patients with Crohn's disease on Prednisolone
 - 1 patient was insulin treated diabetic
 - 1 patient on Octreotide (elevated Hb A_{1c})
- Median weekly glucose of 2000g at 11.8mg/kg/min
- Median Hb A_{1c} 3.1% (normal 2.8-4.9%)

Conclusion: No correlation between glucose infusion and Hb A_{1c}

Systematic review: Lipids in HPN

Summary of results from the three included studies.

Reference	Study details	IVLEs used	Liver function tests	Inflammation and peroxidation indices	Clinical outcomes
Rubin et al., 2000 [13]	RCT, adults, n = 22, 4 weeks	SO vs structured SO-MCT	SO: ALP, ALT, AST & γ -GT abnormal in 2 patients	Similar lipid peroxidation	Similar clinical safety and AEs (Vomiting n = 5 for SO-MCT, n = 4 for SO).
Vahedi et al., 2005 [15]	RCT, adults, n = 13, 3 months	SO vs OO-SO	No differences	No change or difference in C-reactive protein	Similar AEs
Klek et al., 2013 [14]	RCT, adults, n = 75, 4 weeks	SO vs SMOF	Normal but ALT, AST & total bilirubin lower with SMOF (p = 0.049, 0.027 and 0.043)	Increase in serum α -tocopherol with SMOF (p < 0.05) No change or difference in IL-6, sTNF-RII or C-reactive protein	Serious AEs more frequent with SO (p = 0.03)

ALP = alkaline phosphatase, γ -GT = gamma glutamyl transpeptidase, AST = aspartate transaminase, IL-6 = interleukin-6, sTNF-RII = soluble tumour necrosis factor receptor II.

Conclusion: There may be benefits in using alternative lipids rather than pure soya oil in adults on HPN, but there are currently too few RCTs to reach a firm conclusion

ESPEN guidelines: Lipid

	Grade of evidence	Strength of recommendation
We suggest, in patients on TPN, a minimal supply of 1g/kg/week of IV lipid containing EFA, to prevent EFA deficiency	Very low	Weak
We suggest most patients on HPN without ongoing metabolic complications be safely treated with the provision of no more than 1g/kg/d of IV soybean lipid emulsion	Very low	Weak

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Essential fatty acid deficiency

- Patients at risk if on PN with limited oral intake
- Can develop signs and symptoms within 3 weeks
- Dermatitis, steatosis, haematological disturbances, reduced immune function

56 HPN patients

- Assessed EFA status
- At risk if <200cm and no IV lipid
- 500ml of 20% Intralipid once a week was adequate

Jeppesen *et al* (1998) *Am J Clin Nutr*, 68:128

- Oral & cutaneous sunflower and safflower oil can treat EFAD if on lipid free PN

EFAD & Lipid study

Methods

- Fatty acid status assessed in 30 HPN patients (with limited oral intake)
- Short bowel n=15, motility n=9 & other n=6
- Lipid 0.97g/kg 80:20% Olive:soya (Clinoliec®)

Results

- No evidence of biochemical or clinical EFAD

Conclusion

- Clinoliec® does not result in EFAD

Olthof *et al* (2016) JPEN, 40:982

Roongpisuthipong *et al* (2012)BMJ Case Rep, Jun 14

Micronutrients: what should you do?

It depends

- Which tests analysed at your Trust?
- What has to be sent away?
- How long does it take to get results?
- How do you interpret the results?

Interpretation

CRP

<15mg/L	Reliable
15-50mg/L	Unlikely to be reliable
>50mg/L	No value

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ESPEN Guidelines: Micronutrients

	Grade of evidence	Strength of recommendation
Baseline serum vitamin concentrations be measured, according to laboratory availability, at the onset of HPN and then at least once a year	Very low	Strong
Baseline serum trace element concentrations be measured, according to laboratory availability, at the onset of HPN and then at least once a year	Very low	Weak

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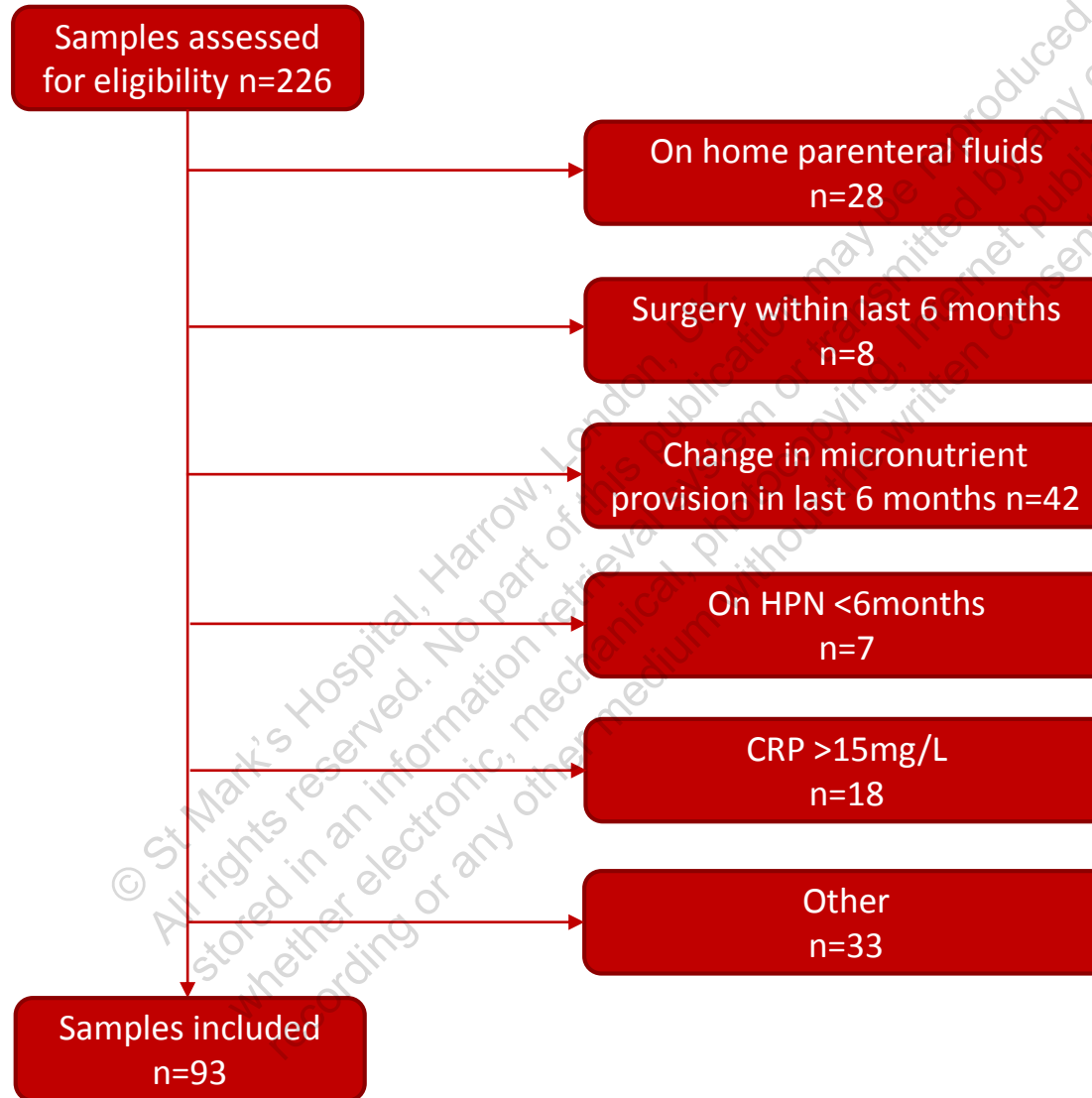
Micronutrient audit

- We aimed to assess the micronutrient status of stable HPN patients and assess factors associated with any deficiencies

Method

- A retrospective analysis was performed on venous blood samples from patients receiving home parenteral support
- This included vitamins A, E, D, B12, folate, zinc and selenium
- Patients were excluded if on home parenteral fluids, had undergone surgery or a change in micronutrient provision in the previous 6 months or been on HPN for <6 months
- To avoid the effect of the acute phase response samples were excluded if C-reactive protein (CRP) >15mg/L (Duncan *et al* 2012, *Am J Clin Nutr*,95:64)
- Demographic data was collected including age, sex, aetiology and body mass index (BMI)
- Number of days/week on HPN, Cernevit® and Additrace® were recorded

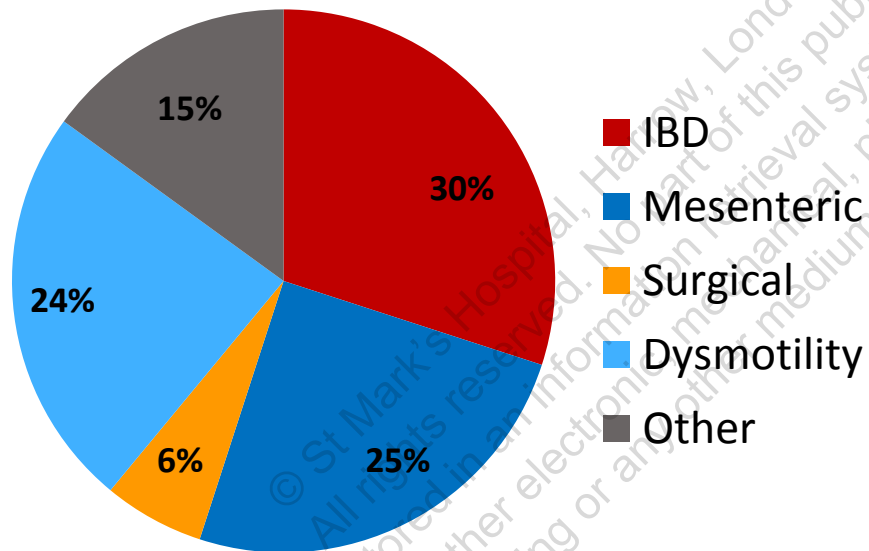
Results – inclusion/exclusion



Results - Demographics

33M:60F, mean age 54 ± 14 years, mean BMI: $21.8 \pm 3.1 \text{ kg/m}^2$

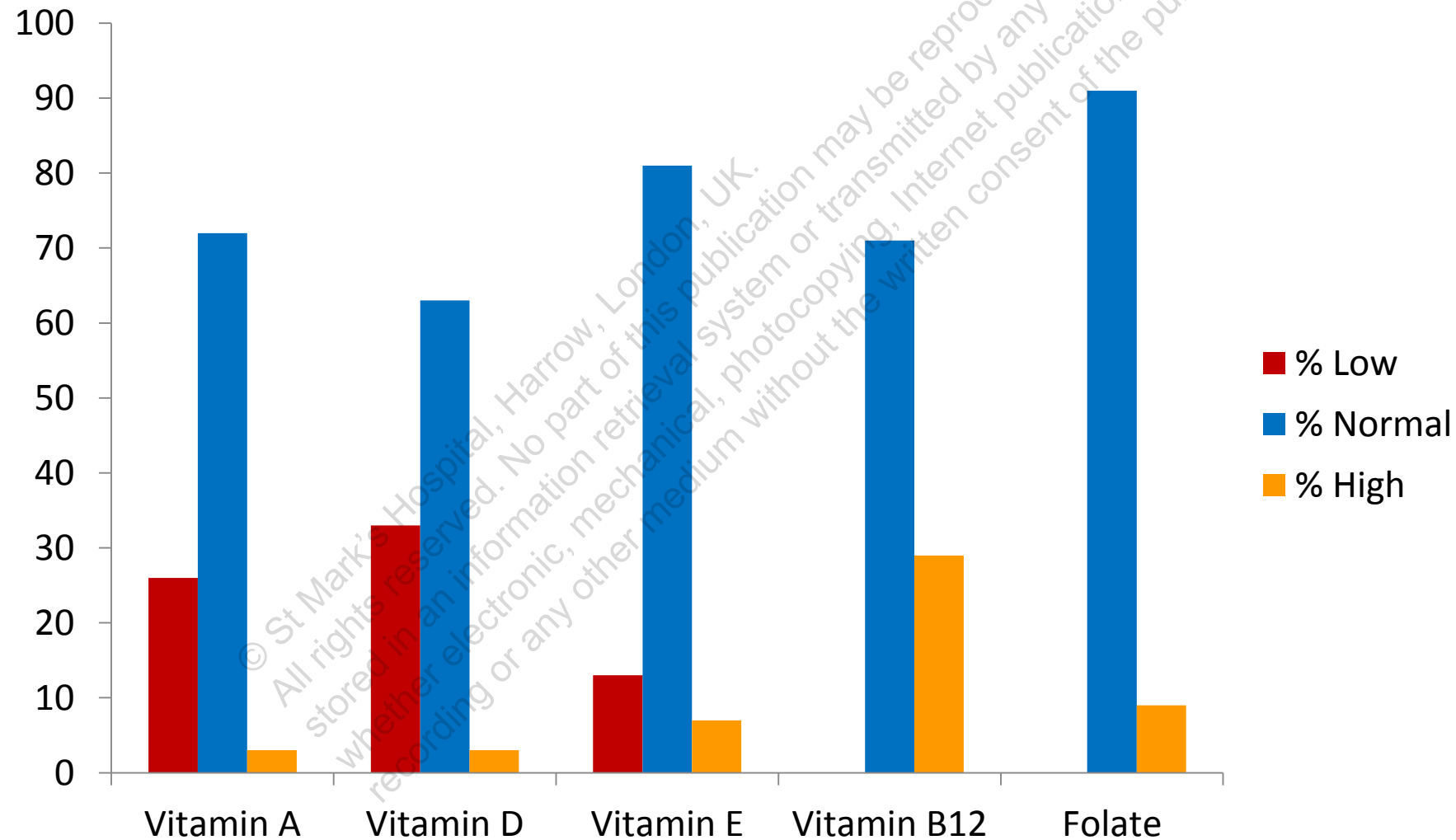
Patient aetiology



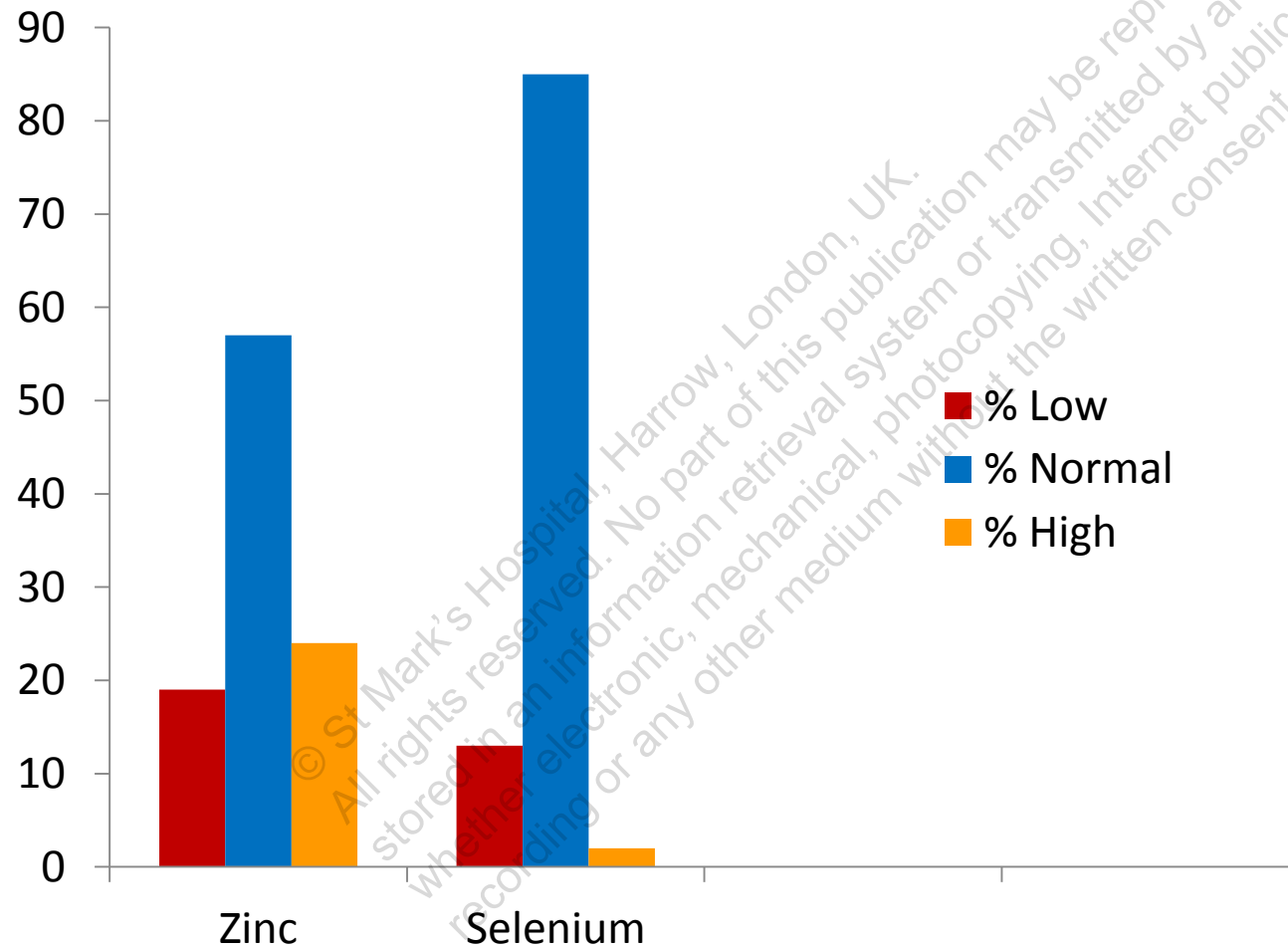
Frequency of HPN, Cernevit[®] and Additrace[®]

	Mean number of days/week
HPN	5.7 ± 1.5 (range 2-7)
Cernevit [®]	4.7 ± 1.6 (range 2-7)
Additrace [®]	5.7 ± 1.6 (range 2-7)

Percentage of patients with low, normal and high serum vitamin concentrations



Percentage of patients with low, normal and high trace element concentrations



Factors associated with deficiencies

Micronutrient	Significant associations on univariate analysis	P value
Vitamin A	Age < 50years	0.02
Vitamin E	Male	0.02
Zinc	Surgical complications	0.007
	BMI > 25kg/m ²	0.01*
	Additrac [®] <4days/week	0.06
Selenium	Surgical complications	0.04

*Multivariate analysis

- No associations observed for vitamin D
- No associations observed with intestinal anatomy

Discussion

- Micronutrient deficiencies were observed in our HPN population but age, sex, aetiology, intestinal anatomy, BMI, number of days on HPN, Cernevit[®] and Additrace[®] were not consistently associated with deficiencies
- Vitamin A and D deficiencies may require oral or intramuscular supplementation
- Vitamin B12 and folate require ongoing monitoring to prevent excess provision from supplementation in addition to Cernevit[®] in HPN
- Zinc and selenium deficiencies could be treated with new trace element preparations containing higher amounts
- Ongoing monitoring important

Vitamin D status in HPN patients

Ref	Numbers & location	Vitamin D (nmol/L)	Deficiency	Insufficiency	Treatment & outcome
1	199 (UK)	62 ± 37	37% deficient (8% severely)	27%	High IM dose but levels remained suboptimal Not associated with gender, age or IF aetiology
2	22 (Canada)	42 ± 22	68%	27%	Supplementation required
3	14 (Canada)	52 (43–53)	Not reported	35%	Oral supplementation insufficient
4	78 (Sweden)	45 ± 27	67% (23% severely)	20%	Oral doses needs to exceed usual requirements
5	79 (USA)	25 ± 13	44%	30%	Oral supplementation insufficient

1. Tee *et al* 2010, UEGW 2979. 2. Thompson & Duerksen 2011, JPEN, 355:499. 3. Kumar *et al* (2012) JPEN, 36:463. 4. Ellegard *et al* (2013) Clin Nutr, 32:983. 5. Bharadwaj *et al* (2014) Nutr Clin Pract, 29:681.

Treatment

- Ergocalciferol 300,000IU IM stat dose
- Second dose 3-4 months later, or by high dose oral therapy where appropriate
- Hospital oral liquid preparation 3,000 units/ml
 - ▣ 15ml ONCE A WEEK
 - ▣ Does not contain gelatin or peanut oil. Suitable for vegetarians, vegans, and those with nut allergies. Halal compliant

Selenium

Deficiency common in HPN¹

Treatment depends on concentration

- IV 500ug for three days
- Recheck concentration one month later
- Try oral 100-500ug/day
- Double dose in PN

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Manganese

Elevated concentrations common¹ especially PNALD²

Evidence of deficiency? Can we avoid?³

Treatment depends on concentration. How high?

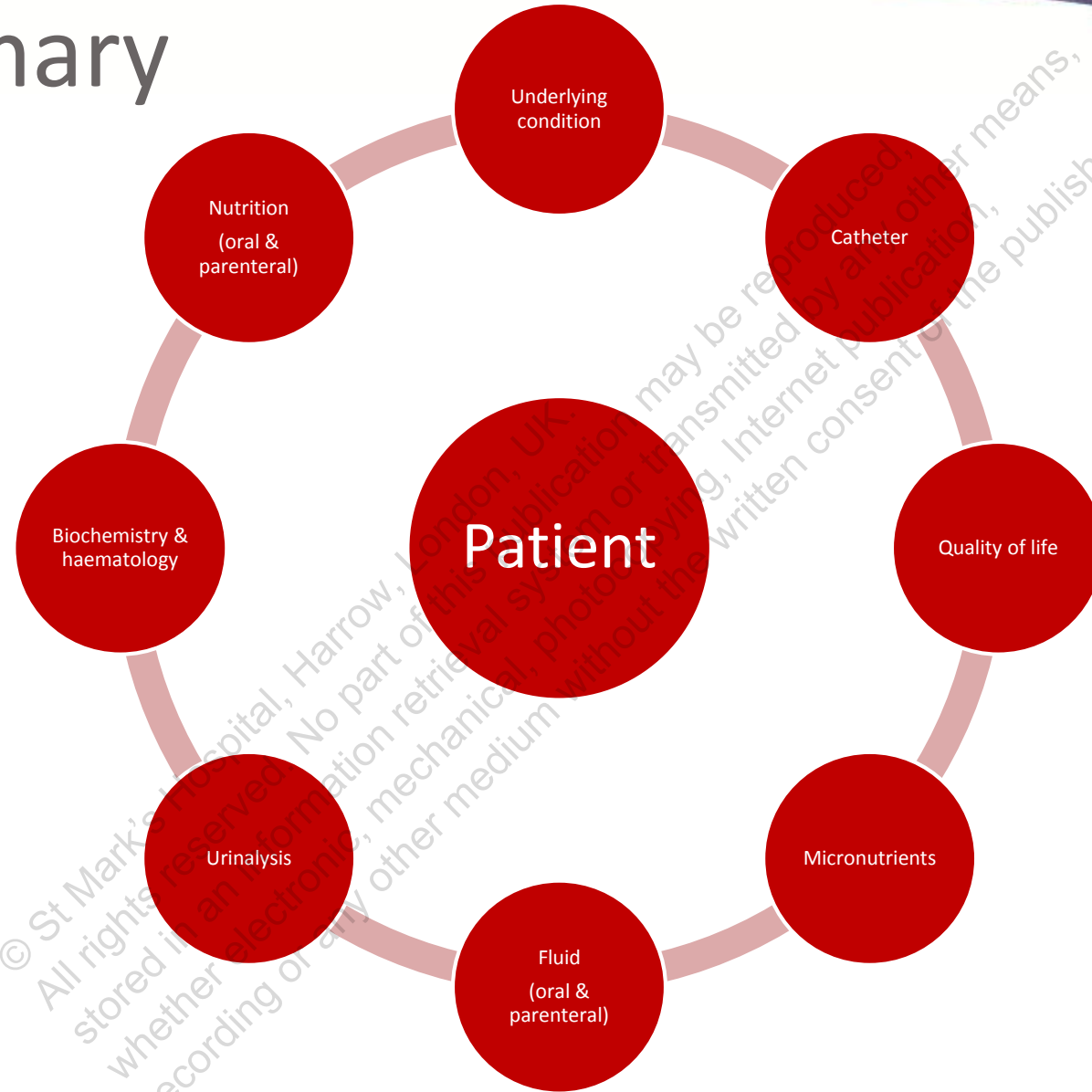
- Change to Nutryelt or Addaven
- Remove Additrac and replace other trace elements

Suggestions for monitoring micronutrient status

- Ensure complete nutrition daily (diet & parenteral)
- Verify adherence to nutrition prescription
- Correlate findings with medical history & physical examination
- Supplement suspected/proven deficiencies and then reassess
 - Monitor for subsequent toxicity after prolonged supplementation
 - Monitor for subsequent deficiency after prolonged omission
- Monitor laboratory, clinical & physical response to nutrition interventions
- **AGA Guideline** Buchman *et al* (2009) *Gastroenterology* 137, 5:S1-134

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Summary



Rapid access to advice / care from MDT